Message

From: Dan Pope [DPope@css-inc.com]
Sent: 4/19/2017 7:29:39 PM
To: Bo Stewart [Bo@praxis-enviro.com]; Davis, Eva [Davis.Eva@epa.gov]; Steve Willis [steve@uxopro.com]; Wayne Miller [Miller.Wayne@azdeq.gov]; Jennings, Eleanor [Eleanor.Jennings@parsons.com]; d'Almeida, Carolyn K. [dAlmeida.Carolyn@epa.gov]; Brasaemle, Karla [KBrasaemle@TechLawInc.com]; Cosler, Doug [DCosler@TechLawInc.com]
Subject: RE: Time of Remediation Estimates for EBR

Bo indicates: "Averaging does what it says, it averages such that pockets of RAO exceedances are allowed in the volume, is this acceptable and begs the question on what scale will "success" be measured?"

This is one of the reasons that the details of the performance monitoring scheme are so important.

Pertinent quote from our previous memo:

> "It appears that the endpoints for EBR ("100 to 500 µg/L", "EBR will be implemented to achieve conditions…", as quoted above in the Introduction section of this review) are vague and somewhat arbitrary, in that:
>
> > 1) the endpoint contaminant concentrations indicated for EBR ("100 to 500 µg/L") encompass a wide range,
> >
> > 2) no particular sampling locations are specified (e.g., sampling locations providing data representative, in a statistically valid and defensible way, of the various subsurface zones throughout the Site) for providing the concentration data to be used for determining the endpoint,
> >
> > 3) no approach is specified for determining that the endpoint concentration has been met (e.g., a statistically valid, non-arbitrary procedure for analyzing the data…" (January 2016 memo)

-----Original Message-----
From: Bo Stewart [mailto:Bo@praxis-enviro.com]
Sent: Wednesday, April 19, 2017 1:18 PM
To: Davis, Eva; Steve Willis; Wayne Miller; Jennings, Eleanor; d'Almeida, Carolyn K.; Dan Pope; Brasaemle, Karla; Cosler, Doug
Subject: Re: Time of Remediation Estimates for EBR

Hi Eva,

Maybe I should emphasize that these are theoretical modeling results - mathematical relationships with estimated parameter inputs. The discussion then goes to what the model does and doesn't include, what the model assumes, and what the appropriate input parameters are. Will the SRB grow significantly? What is the lag time for SRB to acclimate (not included in the model)? Inhibition is not considered, nutrient availability is not included. Averaging does what it says, it averages such that pockets of RAO exceedances are allowed in the volume, is this acceptable and begs the question on what scale will "success" be measured?

I agree that field conditions will not be well mixed on the larger scale of the volume-averaging and this is supposed to be captured mostly in the mass transfer coefficient. The mass transfer coefficient is scale dependent. A smaller mass transfer coefficient may be appropriate but I had no real technical basis for lowering it based on the results of the mass

transfer test. However, if you look at the first order calculations with a mass transfer coefficient of 0.005 1/day, the LSZ timescale increases to 21 to 69 years (Table 7) , assuming the SRB will grow.

I tried to stay away from any interpretation in the memo, I'm not an expert on the bio, just a mathematician in this case with input and output. But based on the model and assumptions, I don't see a 20-year timeframe in the LSZ (I lean toward the literature based NAPL volumes) unless all goes perfectly and the UWBZ looks like a century. I will leave it to others to point out the limitations of the model compared to the reality of sulfate reduction at ST012.

Based on the model and its input, the big picture questions for the first phase, as have been stated by others and the EBR Decision Tree,
include:

1. Is the SRB mass growing as needed? And not dying?

2. Will highly concentrated injections be inhibitive?

3. How well distributed does the sulfate become with respect to the NAPL locations?

4. Is benzene slower to degrade than other aromatics or average, faster?

5. How much monitoring and tweaking will be required and over how long a period to sustain the degradation if it does get going?

6. Should a period of rebound be included in the first phase to assess how fast does rebound occurs (mass transfer rate) and to what concentration (how much actual depletion of the NAPL occurred)?

Bo

PS. Accuracy is not be implied by the number of significant digits presented in the memo, those are only for relative comparisons.

On 4/19/2017 10:15 AM, Davis, Eva wrote:
> So - how comparable are the results from the two different modeling efforts? I admit I'm a skeptic - I am having a hard time believing the time ranges that Bo calculated, they still appear optimistic to me. If the bugs really could do that much, why did we do SEE at all?
>
> I think at least part of the answer is in one of Doug's comments - 'field conditions will definitely not be well-mixed (e.g., highly-variable permeability) which means that the actual system will not perform as well" and that this should be emphasized up front
>
> -----Original Message-----
> From: Bo Stewart [mailto:Bo@praxis-enviro.com]
> Sent: Tuesday, April 18, 2017 4:49 PM
> To: Steve Willis <steve@uxopro.com>; Wayne Miller <Miller.Wayne@azdeq.gov>; Jennings, Eleanor <Eleanor.Jennings@parsons.com>; d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>; Davis, Eva <Davis.Eva@epa.gov>; Dan Pope <DPope@css-inc.com>; Brasaemle, Karla <KBrasaemle@TechLawInc.com>; Cosler, Doug <DCosler@TechLawInc.com>
> Subject: Time of Remediation Estimates for EBR
>
> Hi All,
>

> Steve asked me to go ahead and forward the attached memorandum. The memo describes modeling and calculations for the time to attain RAO-like results (averaged over the NAPL source zones) using EBR. The approach is similar to Doug's in his spreadsheet. The model description and mathematical equations (Appendix B) were reviewed by Michael Brooks at EPA ORD (excluding the Monod kinetics) when it was used in the FFS at the McCormack & Baxter Superfund site in 2014. It was also used for the FFS at the Wyckoff Superfund site. I had to add the Monod kinetics to make it applicable to EBR at ST012.
>
> The model is only applied to the EBR targets defined in the Amec Worksheets for the NAPL remaining (LNAPL Volume Calcs Printable_Rev_030317). No attempt was made to evaluate the TTZ/TIZ since no viable mass estimate exists for the residual NAPL remaining after SEE.
>
> For the assumed field conditions and the underlying model assumptions for Monod kinetics, the range of estimates for the LSZ is 8 to 23 years.
> The calculated range for the UWBZ is 92 to 136 years. Allowing undefined improvements to yield a 10-fold increase to the utilization rates in the UWBZ resulted in a calculated range of 17 to 43 years.
>
> Bo
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Lloyd "Bo" Stewart, PhD, PE
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